**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, D.C. 20554**

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| In the Matter of | ) | |
| | ) | |
| Wireless Telecommunications Bureau seeks comment on petitions regarding the use of signal boosters and other signal amplification techniques used with wireless services | ) | WT Docket No. 10-4<br>Released Jan 6, 2010 |
| | ) | |

# NOTICE OF EXPARTE COMMUNICATION
# MILLARD/RAINES PARTNERSHIP
## ("SMART BOOSTER")

Smart Booster
Intelligent Cellular Range Extender

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## Introduction

Michael Millard and Jeremy K. Raines, Ph.D., P.E., inventors of the Smart Booster, are pleased to submit the following Ex Parte Communication to WT Docket 10-4.

In January 2010, the FCC invited comments concerning signal boosters and cellular communication networks. Smart Booster has submitted four separate responses to that invitation, on February 4, March 8, June 3, and July 1, 2010. They discussed the many reasons why an intelligent booster is the only device that will simultaneously resolve concerns of carriers regarding interference, the public need for wireless service where coverage is presently unusable or marginal, and an impractical enforcement burden on FCC field personnel.

In this present filing, we continue the discussion by providing additional reasons to accept intelligent boosters as an integral part of present and future wireless networks. In particular:

1. The Smart Booster can be equipped with a “kill switch” so that a service technician, using an inexpensive and portable remote control unit, can identify and disable a malfunctioning booster. Together with the memory card feature, the kill switch provides carriers with the authorization and ultimate control over boosters that they have requested.
2. Downlink sensing, an adaptive scheme that has been proposed as an alternative to intelligent boosters, is a fundamentally flawed concept. Actual

measurements demonstrate this. There is no viable substitute for an intelligent booster.

3. Intelligent boosters will extend wireless coverage to regions far beyond the reach of traditional base stations, on land and at sea, while avoiding any harmful interference.

## 1. The Smart Booster "Kill Switch" Feature Satisfies Carrier Demands for Ultimate Control of Signal Boosters.

Carriers demand rigorous control of boosters operating on their networks, and Smart Booster agrees that such control is beneficial to both carriers and consumers. We disagree, however, concerning the engineering details for implementing that control. In its May 2010 Ex Parte Presentation, AT&T requested that the Commission codify safeguards to protect networks from interference due to boosters.[1] Smart Booster currently provides all but one of the requested safeguards. The remaining safeguard, which AT&T terms "dynamic" over-the-air control of boosters, is simply not possible using existing signal protocols.

With this filing, Smart Booster announces its new "Kill Switch" feature that will provide carriers the ultimate control of boosters that they have been seeking. Using the kill switch, as shown in Fig. 1, carriers can deactivate individual malfunctioning boosters via remote control, independent of over-the-air signaling protocols that are standard on the various networks.

[1] AT&T Ex Parte Communication, WT Docket 10-4, May 28, 2010, p1

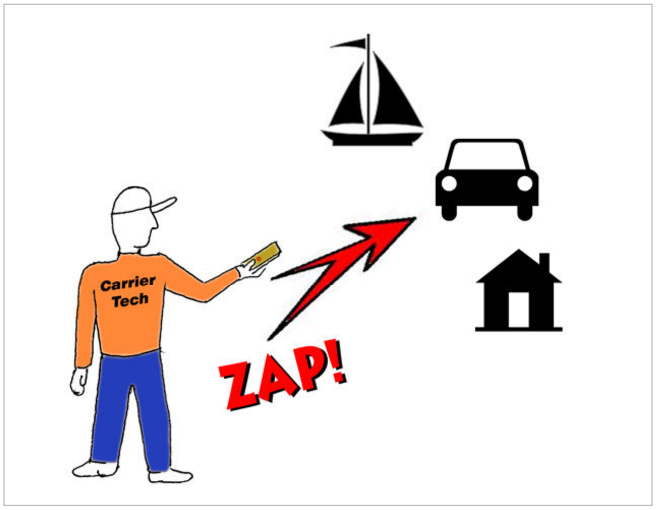



**Fig. 1** The kill switch feature of the Smart Booster allows an authorized service technician to disable a malfunctioning device from a range of 200-400 feet. This provides the ultimate safeguard requested by the carriers and relieves the FCC Enforcement Bureau of a huge burden.

The Smart Booster kill switch comprises a low-power Part-15 radio telemetry link, for example, using the electronic module shown in Fig. 2, with a usable range of between 200 to 400 feet. This link communicates information about the ownership, location, and operating parameters of the booster, and allows an authorized technician to deactivate the booster whenever necessary.

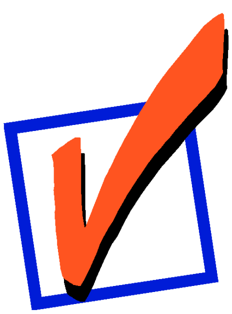
Based upon conversations with carrier employees and contract personnel who actually detect and remedy BDA interference in the field, the low-power range of 200 to 400 feet specified above is near optimal. However, if necessary, the usable range may be extended up to six miles using a more expensive, commercially available telemetry link.

Because the Smart Booster is already under carrier control by virtue of its memory card, we anticipate that the kill switch feature will hardly ever be used; however, it satisfies the desire of carriers for ultimate control over boosters in the case of malfunctions.


Fig. 2

An XBEE Part-15 Low-Power or equivalent telemetry module is part of the Smart Booster, allowing a technician to deactivate it with a remote control unit.

With the addition of the kill switch, the Smart Booster now satisfies all of the desired safeguards requested by the carriers. The remaining safeguards have already been satisfied by the Memory Card of the Smart Booster. For example, the card effectively enforces authorization of boosters by the carriers because only they can issue it. Further, the Memory Card constrains operation to only those channels licensed to a particular carrier at particular locations.



## The Smart Booster's "Kill Switch" Greatly Simplifies Enforcement Bureau Efforts and Scheduling

In addition to satisfying demands by carriers, the kill switch also removes much burden for enforcement from the FCC. Carriers can terminate interference events by directly disabling the booster. Once a booster is disabled, it is no longer urgent for FCC Field Enforcement Bureau personnel to remedy interference in person. Administrative follow-up by the Bureau may proceed with much greater freedom, convenience, and efficiency.

## 2. Downlink Sensing Is a Fundamentally Flawed Idea and Not a Viable Alternative to Intelligent Boosters.

Downlink signal sensing has been suggested as an adaptive means to prevent interference to cellular networks; however, Smart Booster is convinced that, based upon both theoretical and experimental evidence, that approach is fundamentally flawed.

Wilson Electronics, Inc., a Petitioner in these proceedings, and a strong advocate of downlink sensing, has cited a smorgasbord of inconsistent thresholds for signal intensity and distance from the tower at which its boosters will deactivate.[2] Regardless of the exact values chosen, all downlink signal sensing techniques suffer from an unavoidable compromise: That is, they either interfere with base stations by allowing booster operation practically everywhere, or they create a coverage map resembling Swiss cheese, the holes of which result from false positives.

With respect to interference, Wilson Electronics argues that its boosters satisfy a requirement established by Verizon. That requirement states that 15 boosters at a distance of 1 mile cannot raise the noise floor at the base station by more than 1 dB. Using simple arithmetic, Smart Booster showed that Wilson's argument is not correct, or even close to correct. For the present discussion, however, we can set aside that disagreement because it does not matter who is correct. The following simple model

[2] Reply Comments of Wilson Electronics, 3/8/2010, p2; Letter of James Wilson (Reply Comments), 3/8/2010 pp 5-6; Ex Parte Reply Comments of Wilson Electronics "Noise Floor Power in Cell Phone Booster Amplifiers", Kline, Cook & Van Buren, 5/5/2010, pp 1, 6-10; Ex Parte Reply Comments of Wilson Electronics "Wilson's Comments on Verizon's Technical Issues", Kline, Cook & Van Buren, 5/11/2010, p4; Ex Parte Reply Comments of Wilson Electronics "In Car Cellular Signal Boosters – White Paper for Wilson Electronics", Andrew Seybold, 4/10 (filed 5/13/2010), pp 7-8; Ex Parte Reply Comments of Wilson

will show that, ultimately, the number of boosters and their proximity to base stations must cause interference in excess of Verizon's requirement.

It is easy to show that interference quickly gets out of hand as a function of the number of boosters and their distance from the base station. This is easily seen by referring to Fig. 3.

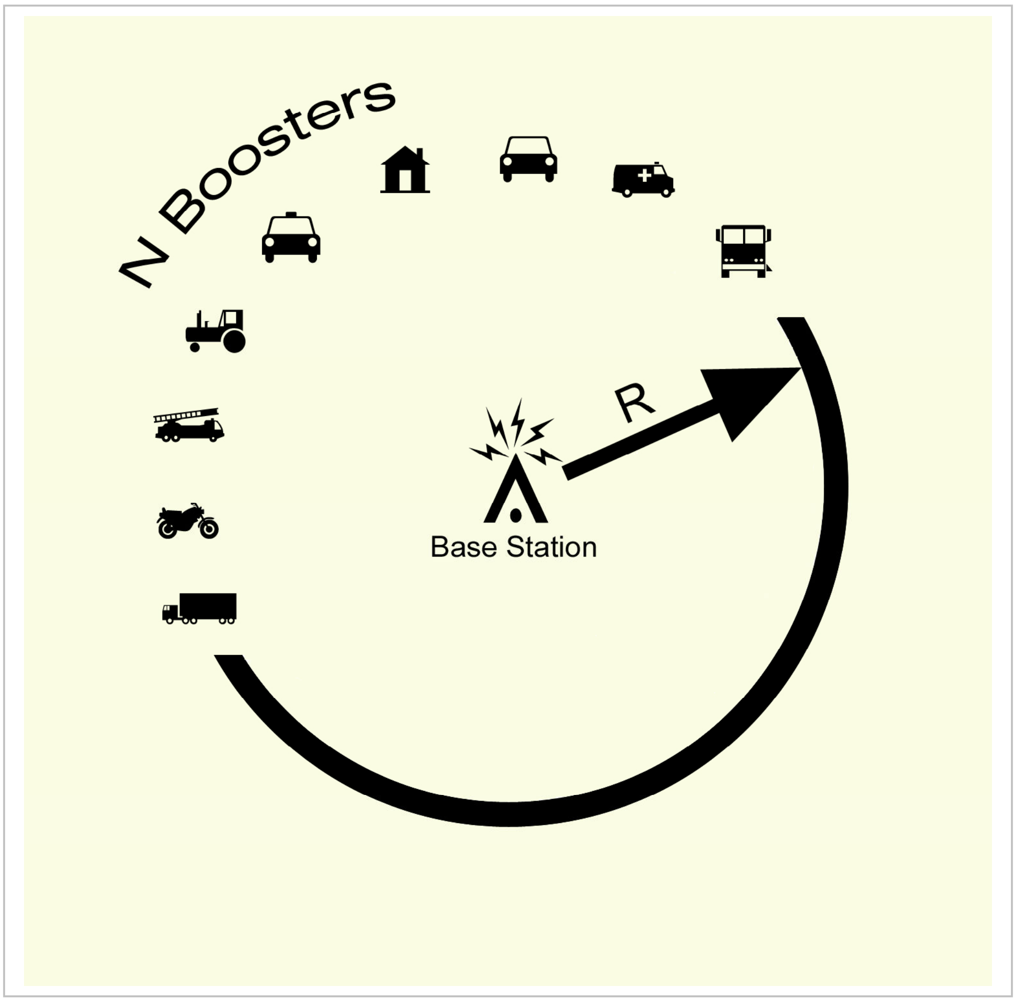



Fig. 3. The Verizon standard for tolerable interference from boosters is expressed in terms of N boosters, which may be located in a variety of vehicles or buildings, at a distance R from a base station.

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Electronics, "Gain Balance in Cell Phone Booster Amplifiers", Kline & Van Buren, 6/9/2010, p2; and Ex Parte Reply Comments of Wilson Electronics, 6/28/2010, pp 1-3.

How does the power incident upon the base station change as the number of boosters increase and as the distance decreases? The answer follows from a simple formula. The power is proportional to the number of boosters and inversely proportional to their distance from the base station. That is,

$$\frac{P}{P_0} = \frac{N}{N_0}\left(\frac{R_0}{R}\right)^2 \qquad (1)$$

The variables in eqn. 1 are all linear, but we can easily derive the equivalent equation in decibel terms by taking the logarithm of both sides and multiplying by 10:

$$10\log\left(\frac{P}{P_0}\right) = 10\log\left(\frac{N}{N_0}\right) + 20\log\left(\frac{R_0}{R}\right) \qquad (2)$$

Eqn. 2 tells us how the Verizon standard is quickly exceeded by a likely change in the number of boosters and their distance from the base station. According to the standard, $N_0$ = 15 units, and $R_0$ = 1 mile = 1609 meters. Let's consider a situation that may well occur, for example, near a sports stadium. Suppose users with 100 boosters converge on the stadium parking lot, only 0.13 mile from a base station at that stadium. That is, N = 100, and R = 0.13. Eqn. 2 tells us that the increase in power incident on the base station from the boosters will be:

$$10\log\left(\frac{100}{15}\right)+20\log\left(\frac{1}{0.13}\right)=25.96\ dB \qquad (3)$$

That is, the power incident on the base station from the boosters will be 394 times greater than the amount produced by 15 boosters at a distance of 1 mile. Obviously, this is going to cause serious problems.

Verifying the above mathematical model for interference, experimental testing of a Wilson Electronics booster in the parking lot adjacent to a cell site clearly demonstrates that downlink signal sensing techniques do not prevent boosting in locations and in situations that are, in fact, detrimental to the cellular network. A Wilson Model 801201, with FCC ID PWO8012ASM, was installed in a passenger automobile according to the manufacturer's user manual. The vehicle was then driven to the Best Buy parking lot surrounding ASR Tower # 1221544 in Boca Raton, Florida, as shown in Fig. 4.

From this location, calls were made on both the AT&T and Sprint networks.[3] The first round of calls was made with the booster unplugged, and hence, not amplifying. The spectrum analyzer display of the uplink signal is shown in Fig. 5. The second round of calls was made with the Wilson booster activated. The uplink signal is shown in Fig. 6.

[3] Sprint FCC License: KNLF229 (PCS-A Block, MTA015, Miami-Fort Lauderdale), Issued to Wirelessco, L.P.


**Fig. 4** This photo is taken from the location of the Wilson booster testing showing the cell site in the distance, approximately 700 feet away. Boosting is not required at this location, yet the Wilson device continues to bombard the site with excessively strong signals, collapsing the intended cell site coverage radius. As a result, subscribers on the edge of coverage may experience dropped calls or be denied service.

**Testing confirms that downlink sensing is not a suitable alternative to the intelligence that results from combining GPS location awareness with a memory that provides knowledge of that location and its surroundings.**

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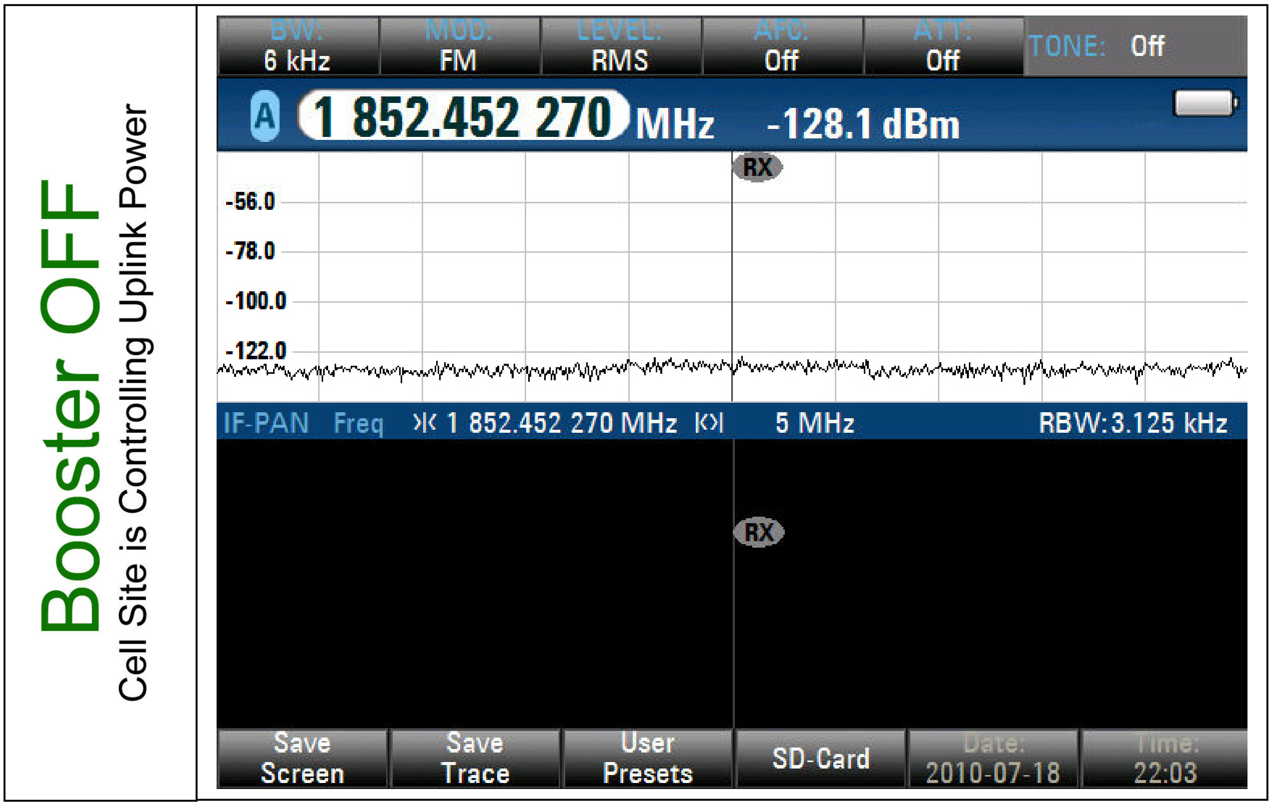


Fig. 5 Call established with the Wilson booster turned OFF.

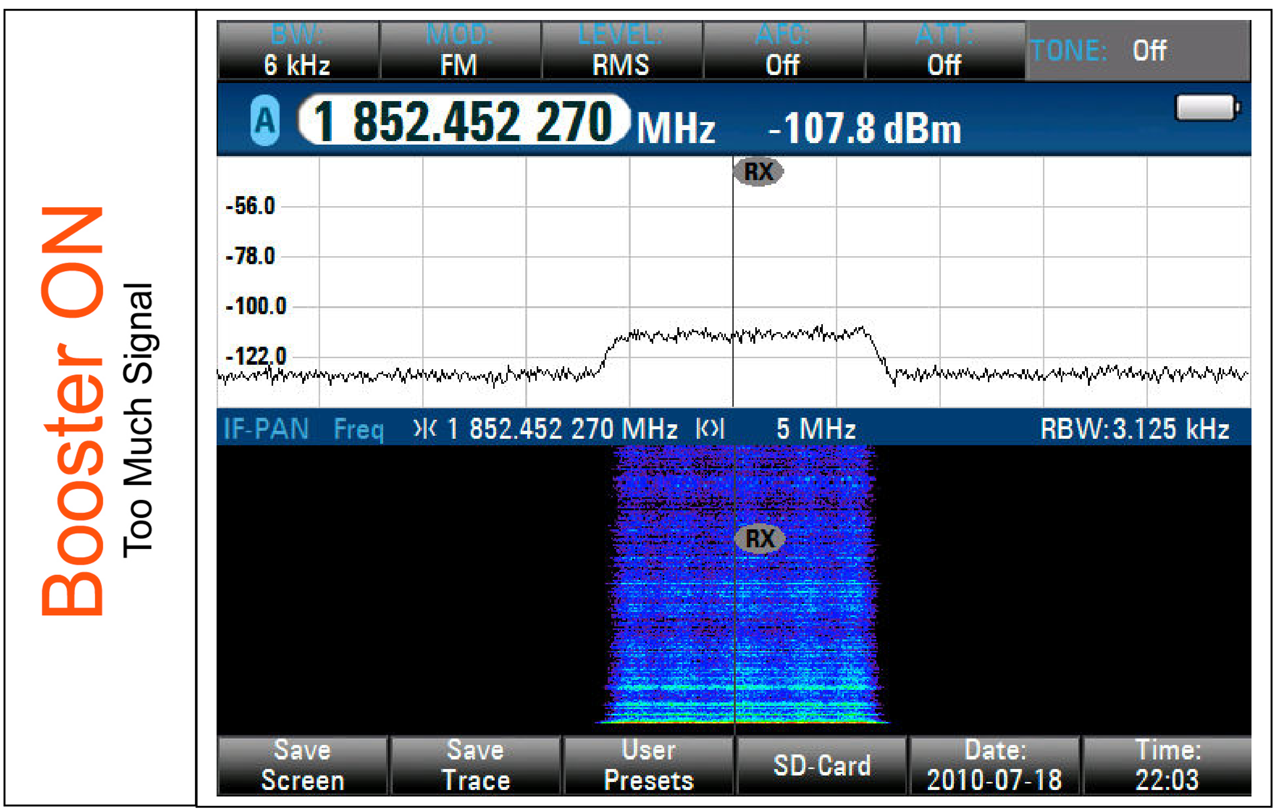


Fig. 6 Wilson booster is turned ON, providing 100 times more signal than required.

As seen in Figure 5, Sprint's mobile uplink spectrum is controlled by the cell site such that the handset's signal is barely visible above the uncalibrated noise floor. This is the expected graph for a handset that is engaged in conversation in close proximity to a cell tower.

In contrast, Figure 6 shows a grossly over-amplified signal capable of disrupting the power control algorithms employed by Sprint's network. The Wilson booster is providing approximately 20 dB (100 times) more signal in the uplink than was the case without the booster operating.

From the experimental evidence described above, it is clear that adaptive downlink sensing cannot be relied upon to prevent boosting where it is completely unnecessary and harmful in terms of interference.

## 3. Intelligent Boosters Extend Signal Coverage Even Beyond the Earth's Horizon

Straightforward calculations show that an intelligent booster can extend signal range for many tens of miles beyond the boundaries of what is presently covered by traditional base stations. We discuss those calculations in further detail here.

The amplifiers which form the core of any booster are available with a range of gains from about 20 dB to 40 dB, that is, a gain from 100 to 10,000. A signal propagates such that its power density attenuates with the square of distance. So, the amplifier should increase the distance to the minimum usable signal by a factor of 10 to 100, for gains of 20 dB and 40 dB, respectively. For example, if a base station is designed for usable signal to a distance of 5 miles, then the amplifier should ideally increase that boundary to a distance of 50 to 500 miles. We emphasize the qualifier “ideally”. What, in fact, actually happens, with respect to extending signal coverage?

Long before a cell phone is 50 to 500 miles away from a base station, line of sight is broken by the curvature of the earth. How much attenuation is caused by that curvature? Fig. 7, calculated using knife-edge diffraction theory, shows the answer for a range of base station heights from 100 to 400 feet above ground level. It is seen that the signal attenuates by 20 dB at a distance of about 25 miles beyond the horizon. Further, this attenuation is practically independent of the height of the base station. It follows that a booster can extend signal coverage even beyond the horizon.

In view of the above, boosters can clearly provide coverage over much of rural America. Since Interstate highways traversing rural regions are typically covered by traditional base stations, boosters extend that coverage by tens of miles to either side, even beyond the earth’s horizon.

Similarly, boosters can clearly provide coverage far out at sea or over the Great Lakes.

It should be noted with caution that the above is not only a benefit but also a threat from any booster except an intelligent booster. Only an intelligent booster will automatically deactivate at distances where licensing and other considerations prohibit operation.

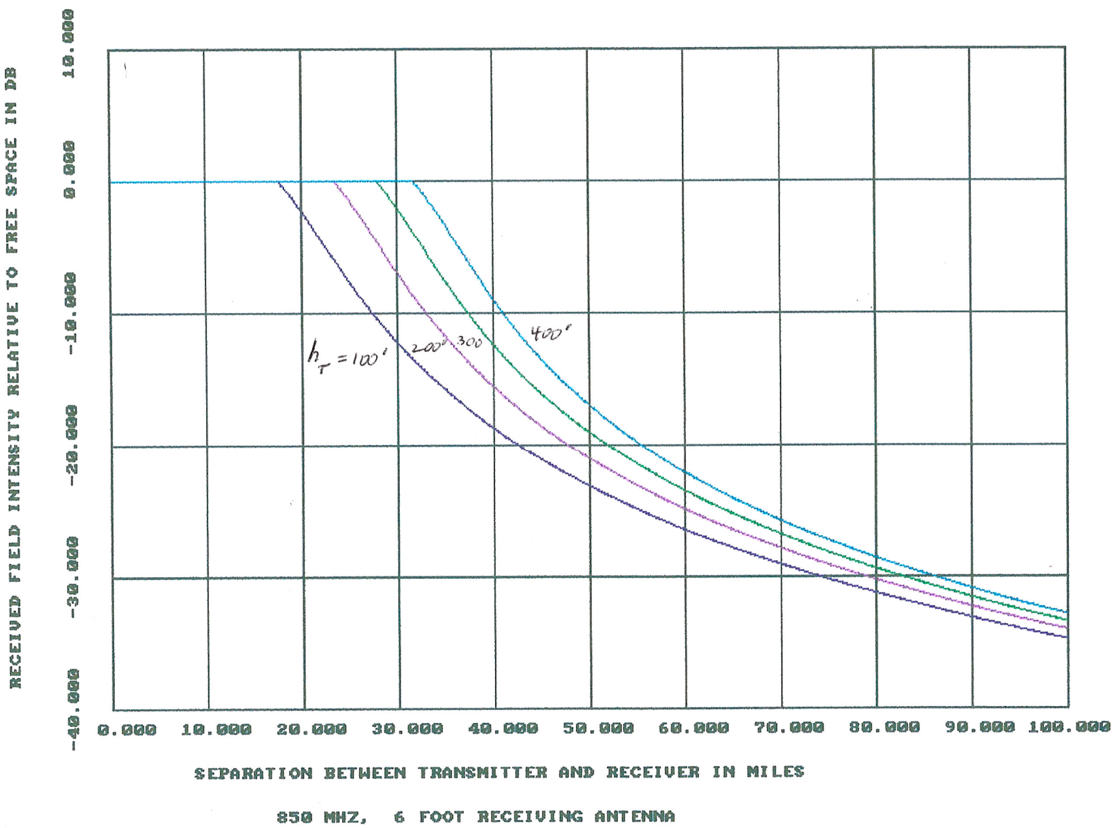


**Fig. 7** Attenuation beyond the earth's horizon was calculated for a range of base station heights ranging from 100 to 400 feet above ground level. This attenuation is in addition to that with increasing free space distance.

With extensive further study, it is possible to assign a percentage improvement in overall signal coverage, for example, "Signal boosters will extend coverage from 90 percent to 99 percent of the US population." For now, however, we can say with certainty that signal boosters can extend the boundaries of signal coverage on both land and sea by many tens of miles.

## Conclusions

Intelligent signal boosters will greatly improve wireless communications. Other boosters will ultimately cripple it with interference. The difference is that intelligent boosters know when and where they should be activated, and when and where they must be deactivated. Intelligent boosters operate solely on spectrum licensed to the carrier.

As we have discussed in this presentation, an essential characteristic of an intelligent booster is memory. The booster must know about its environment in advance. Adaptive techniques, such as downlink sensing, are not a viable substitute.

Carriers have requested ultimate control over signal boosters. The Smart Booster meets that request in two ways. First, its memory is equivalent to authorization because the carriers control its contents and distribution. Second, the kill switch disables malfunctioning boosters. Considering these features together, the Smart Booster now meets all carrier recommended safeguards in anticipation that the FCC will promulgate rules that authorize boosters on carrier networks. They are:

1) *Carriers must retain ultimate control over the boosters on its networks;*
2) *Boosters must be authorized by carriers prior to activation;*
3) *Transmissions must be restricted to authorized frequencies;*

4) *Anti-Oscillation circuitry must be a standard feature;*

5) *Boosters should be tested by the FCC and by industry, and*

6) *The FCC should enforce penalties against non-compliant BDA manufacturers*

After a careful review of the evidence, it is clear that intelligent boosters offer the best solution to multiple serious issues. We urge the Commission to continue its Rule Making efforts to adopt intelligent boosters, and remove offending booster equipment from the marketplace.

Respectfully submitted,

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Dated: September 13, 2010.
VIA: ECFS.

# CERTIFICATE OF SERVICE

I, Jeremy K. Raines, Ph.D., P.E., do hereby certify that on this 13th day of September, 2010, I caused copies of the foregoing "Notice of Ex Parte Communications of Millard/Raines Partnership" to be delivered to the following via electronic or First Class US mail.

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## FCC 2.803 Compliance Notice:

***Prototype - Not for Sale***
*The Smart Booster device has not been authorized as required by the rules of the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased, until authorization is obtained.*

## Intellectual Property Notice: